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(54) SERVICE SCHEDULING METHOD AND BASE STATION

(57) Embodiments of the present invention disclose a service scheduling method and a base station. The method includes: reporting, by a Medium Access Control MAC entity of a carrier, bearer information of the carrier to a Radio Link Control RLC entity; allocating, by the RLC entity, service data and control information to the carrier, and sending the service data and the control information to a data buffer of the carrier; determining, by the MAC entity, a user equipment that needs to be scheduled, and acquiring the service data and the control information from the data buffer; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data, and sending the service data experiencing the packet assembly to the user equipment. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

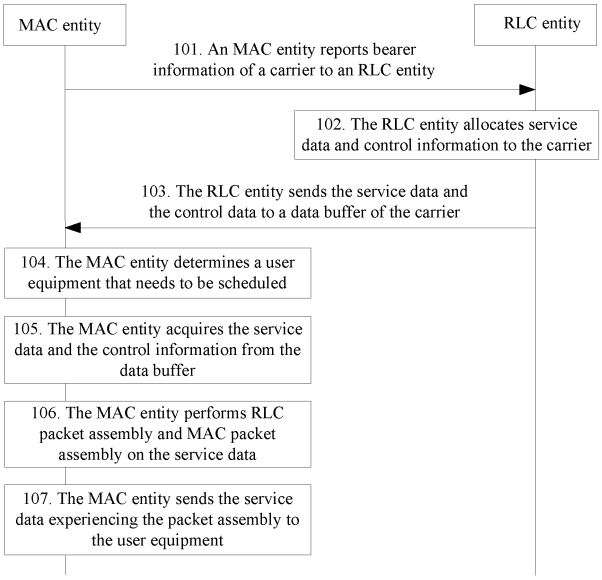

FIG. 1

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relates to the field of communications technologies, and in particular, to a service scheduling method and a base station.

BACKGROUND

[0002] In a Long Term Evolution (Long Term Evolution, LTE) system, a user equipment (User Equipment, UE) may transmit and receive data over multiple carriers (Component Carrier, CC) by using a carrier aggregation (Carrier Aggregation, CA) technology, thereby achieving a better balance between carriers and improving network performance. The carriers may also be called component carriers or carrier units.

[0003] In an existing base station eNB, a Packet Data Convergence Protocol (PDCP, Packet Data Convergence Protocol) entity and a Radio Link Control (Radio Link Control, RLC) entity are managed in a centralized manner, and scheduling of a Medium Access Control (Medium Access Control, MAC) entity and a layer 1 (Layer 1, L1) entity are managed in a decentralized manner. In a multicarrier scenario (for example, N carriers are available), the PDCP entity and the RLC entity may be deployed on a same board (typically a baseband board) with one carrier, and other carriers are separately deployed on different boards. The maximum number of carriers that is supported by a current LTE standard is used as an example, when a peak rate of a single user equipment is 3 Gbps, a Radio Link Control entity of the user equipment outputs a data volume of 3 megabits during a transmission time interval (Transmission Time Interval, TTI); if only one carrier and the RLC entity are on a same board, the volume of data outputted to other boards is 2.4 megabits. If transmission delay is 100 ms as required, a bandwidth required for data transmission between boards is 24 Gbps. If 3 sectors are considered to be supported, a higher bandwidth is required for data transmission between boards.

[0004] Currently it is rather difficult for a baseband unit (BaseBand Unit, BBU) in a base station to meet such a high bandwidth requirement.

SUMMARY

[0005] In view of this, embodiments of the present invention provide a service scheduling method and a base station, so as to solve a problem that a rather high bandwidth is required for transmission between boards.

[0006] According to a first aspect, a service scheduling method is provided, including:

reporting, by a Medium Access Control MAC entity of a carrier, bearer information of the carrier to a Radio Link Control RLC entity;

allocating, by the RLC entity, service data and control information to the carrier, and sending the service data and the control information to a data buffer of the carrier;

determining, by the MAC entity, a user equipment that needs to be scheduled, and acquiring the service data and the control information from the data buffer; and

performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data and sending the service data experiencing the packet assembly to the user equipment.

[0007] In a first possible implementation manner of the first aspect, the bearer information includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

[0008] In a second possible implementation manner of the first aspect, the control information is a number of a logical channel, a sequence number, or a data length of the service data.

[0009] With reference to the first aspect or the first or second possible implementation manner of the first aspect, in a third possible implementation manner, the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

[0010] In a fourth possible implementation manner of the first aspect, the performing, by the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;

if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and

in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

[0011] According to a second aspect, a service scheduling method is provided, including:

reporting, by a Medium Access Control MAC entity of a carrier, bearer information of the carrier to a Radio Link Control RLC entity;

allocating, by the RLC entity, service data and control information to the carrier, and sending the service data and the control information to a data buffer of an RLC agent;

determining, by the MAC entity, a user equipment that needs to be scheduled; and

acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment.

[0012] In a first possible implementation manner of the second aspect, the bearer information includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

[0013] In a second possible implementation manner of the second aspect, the control information is a number of a logical channel, a sequence number, or a data length of the service data.

[0014] With reference to the second aspect or the first or second possible implementation manner of the second aspect, in a third possible implementation manner, the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the RLC agent, and a buffer status of the RLC entity.

[0015] In a fourth possible implementation manner of the second aspect, the acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment is specifically:

sending, by the MAC entity, a service data allocation request to the RLC agent, and performing, by the RLC agent, RLC packet assembly on the service data and sending it to the MAC entity; and performing, by the MAC entity, MAC packet assembly on the service data experiencing the RLC packet assembly and sending it to the user equipment;

or,

sending, by the MAC entity, a service data allocation request to the RLC agent and receiving the service data of the user equipment from the RLC agent; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data of the user equipment and sending the service data experiencing the MAC packet assembly to the user equipment.

[0016] With reference to the fourth possible implementation manner of the second aspect, in a fifth possible implementation manner, the performing, by the RLC agent or the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;

if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and

in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

[0017] According to a third aspect, a base station is provided, including:

a carrier and a Radio Link Control RLC entity, where the carrier includes a Medium Access Control MAC entity and a data buffer;

the MAC entity is configured to report bearer information of the carrier to the RLC entity;

the RLC entity is configured to allocate service data and control information to the carrier and send the service data and the control information to the data buffer; and

the MAC entity is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the data buffer, perform RLC packet assembly and MAC packet assembly on the service data, and send the service data experiencing the packet assembly to the user equipment.

[0018] In a first possible implementation manner of the third aspect, the bearer information of the carrier includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

[0019] In a second possible implementation manner of the third aspect, the control information is a number of a logical channel, a sequence number, or a data length of the service data.

[0020] With reference to the third aspect or the first or second possible implementation manner of the third aspect, in a third possible implementation manner, the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

[0021] With reference to the third possible implementation manner of the third aspect, in a fourth possible implementation manner, the performing, by the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;

if only one sequence number SN is left currently and the service data cannot all be allocated in a current

TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

[0022] According to a fourth aspect, a base station is provided, including:

a carrier, a Radio Link Control RLC entity, and an RLC agent, where the carrier includes a Medium Access Control MAC entity;
the MAC entity is configured to report bearer information of the carrier to the RLC entity;
the RLC entity is configured to allocate service data and control information to the carrier and send the service data and the control information to the RLC agent for buffering;
the RLC agent is configured to buffer the service data and the control information; and
the MAC entity is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the RLC agent, and send the service data to the user equipment.

[0023] In a first possible implementation manner of the fourth aspect, the bearer information includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

[0024] In a second possible implementation manner of the fourth aspect, the control information is a number of a logical channel, a sequence number, or a data length of the service data.

[0025] With reference to the fourth aspect or the first or second possible implementation manner of the fourth aspect, in a third possible implementation manner, the allocating, by the RLC entity, service data and control information to the carrier is specifically:

allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a buffer status of the RLC agent, and a buffer status of the RLC entity.

[0026] In a fourth possible implementation manner of the fourth aspect, the acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment is specifically:

sending, by the MAC entity, a service data allocation request to the RLC agent, and performing, by the RLC agent, RLC packet assembly on the service data and sends it to the MAC entity; and performing, by the MAC entity, MAC packet assembly on the service data experiencing the RLC packet assembly and sending it to the user equipment;
or,
sending, by the MAC entity, a service data allocation request to the RLC agent and receiving the service data of the user equipment from the RLC agent; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data of the user equipment and sending the service data experiencing the MAC packet assembly to the user equipment.

[0027] With reference to the fourth possible implementation manner of the fourth aspect, in a fifth possible implementation manner, the performing, by the RLC agent or the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;
if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

[0028] In the foregoing solutions, an RLC entity allocates service data in advance for a carrier according to information, such as bearer information, reported by an MAC entity, and sends the service data to a data buffer of the carrier or an RLC agent. When the MAC entity needs to schedule a user equipment, it directly reads the service data from the data buffer. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

FIG. 1 is a flowchart of a service scheduling method according to an embodiment of the present invention;
FIG. 2 is a flowchart of another service scheduling method according to an embodiment of the present invention;
FIG. 3 is a schematic structural diagram of a base station according to an embodiment of the present invention; and
FIG. 4 is a schematic structural diagram of another base station according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0030] To make the objectives, technical solutions, and advantages of the embodiments of the present invention more comprehensible, the following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely a part rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0031] The technical solutions in the embodiments of the present invention may be, directly or after an adaptive change, applied to various wireless communications systems, for example: a Global System for Mobile Communications (Global System for Mobile Communications, GSM), a General Packet Radio Service (General Packet Radio Service, GPRS) system, a Code Division Multiple Access (Code Division Multiple Access, CDMA) system, a CDMA2000 system, a Wideband Code Division Multiple Access (Wideband Code Division Multiple Access, WCDMA) system, and a Long Term Evolution (Long Term Evolution, LTE) system.

[0032] FIG. 1 is a flowchart of a service scheduling method according to an embodiment of the present invention. In this embodiment, a multicarrier scenario with N available carriers is used as an example. An RLC entity may be deployed with one carrier on a same board, typically a baseband board, and other carriers CCs are separately deployed on different boards, where other carriers are all configured with a data buffer. For simplicity, FIG. 1 provides only a process of an interaction between one of the carriers and an RLC entity. As shown in FIG. 1, the service scheduling method includes the following steps:

101. An MAC entity of a carrier CC reports bearer information of the carrier to the RLC entity.

[0033] The bearer information includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, a rate that the carrier can provide for a user equipment, and the like.

[0034] It should be noted that in this embodiment of the present invention, the carriers all refer to carriers available for the user equipment. In a multicarrier scenario, a base station may configure and activate one or more carriers for the user equipment, and the carriers available for the user equipment include the foregoing activated carriers and a primary carrier (the primary carrier does not need to be activated).

[0035] In this embodiment, the RLC entity may also be another service entity having a service scheduling function.

[0036] 102. The RLC entity allocates service data and control information to the carrier.

[0037] The control information mainly refers to header information, such as a number of a logical channel, a sequence number, or a data length of the service data, required for performing RLC packet assembly on the service data.

[0038] The allocating, by the RLC entity, service data and control information to the carrier may be specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

[0039] Further specifically, it may be that when the quality of the channel corresponding to the carrier is relatively good, the RLC entity allocates more data and corresponding control information to the carrier, and when the channel quality is relatively bad, the RLC entity allocates less data and even does not allocate data. Certainly, the RLC may further determine, according to a factor such as the load of the carrier and the rate that the carrier can provide for the user equipment, volume of service data allocated to the carrier. This is not limited in this embodiment.

[0040] It should be noted that the RLC entity may allocate data to multiple carriers simultaneously. In this embodiment, only one of the carriers is used as an example, but is not intended to limit the present invention.

[0041] 103. The RLC entity sends the service data and the control data to a data buffer of the carrier.

[0042] The RLC entity may further send an identifier of the carrier or an identifier of the user equipment to the carrier for buffering.

[0043] 104. The MAC entity determines a user equipment that needs to be scheduled.

[0044] The determining, by the MAC entity, a user equipment that needs to be scheduled may be specifically: collecting, by the MAC entity, an ACK or NACK message fed back from the user equipment and when an ACK is received, it considers that the user equipment needs to be scheduled.

[0045] In this embodiment, the MAC entity may schedule multiple user equipments simultaneously. In this embodiment, only one user equipment is used as an example, but is not intended to limit the present invention.

[0046] 105. The MAC entity acquires the service data and the control information from the data buffer.

[0047] 106. The MAC entity performs RLC packet assembly and MAC packet assembly on the service data.

[0048] The performing, by the MAC entity, RLC packet assembly on the service data may be specifically classified into the following several situations:

(1) if radio link control packet data unit segment (Radio Link Control Packet Data Unit segment, RLC PDU segment) packet assembly is performed during a previous transmission time interval (Transmission Time Interval, TTI), performing RLC PDU Segment

packet assembly;

(2) if only one sequence number (Sequence Number, SN) is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and

(3) in a situation rather than the preceding two situations, performing RLC PDU packet assembly.

[0049] 107. The MAC entity sends the service data experiencing the packet assembly to the user equipment.

[0050] In this embodiment, an RLC entity allocates service data in advance for a carrier according to information, such as bearer information, reported by an MAC entity, and sends the service data to a data buffer of the carrier. When the MAC entity needs to schedule a user equipment, it directly reads the service data from the data buffer. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

[0051] FIG. 2 is a flowchart of another service scheduling method according to an embodiment of the present invention. An application scenario is similar to the preceding embodiment, but an RLC agent is added between a carrier and an RLC entity, where the RLC agent is configured with a data buffer, and carriers CCs may not be configured with a data buffer. As shown in FIG. 2, the service scheduling method includes the following steps:

201. An MAC entity of a carrier CC reports bearer information of the carrier to the RLC entity.

[0052] The bearer information includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, a rate that the carrier can provide for a user equipment, and the like.

[0053] In this embodiment of the present invention, carriers all refer to carriers available for the user equipment. In a multicarrier scenario, a base station may configure and activate one or more carriers for the user equipment, and the carriers available for the user equipment include the foregoing activated carriers and a primary carrier (the primary carrier does not need to be activated).

[0054] In this embodiment, the RLC entity may also be another service entity having a service scheduling function.

[0055] 202. The RLC entity allocates service data and control information to the carrier.

[0056] The control information mainly refers to header information, such as a number of a logical channel, a sequence number, or a data length of the service data, required for performing RLC packet assembly on the service data.

[0057] The allocating, by the RLC entity, service data and control information to the carrier may be specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the RLC agent, and a buffer status of the RLC entity.

[0058] Further specifically, it may be that when the quality of the channel corresponding to the carrier is relatively good, the RLC entity allocates more data and corresponding control information to the carrier, and when the channel quality is relatively bad, the RLC entity allocates less data and even does not allocate data. Certainly, the RLC may further determine, according to a factor such as the load of the carrier and the rate that the carrier can provide for the user equipment, volume of service data allocated to the carrier. This is not limited in this embodiment.

[0059] It should be noted that the RLC entity may allocate data to multiple carriers simultaneously. In this embodiment, only one of the carriers is used as an example, but is not intended to limit the present invention.

[0060] 203. The RLC entity sends the service data and the control data to the data buffer of the RLC agent.

[0061] The RLC entity may further send an identifier of the carrier or an identifier of the user equipment to the RLC agent for buffering.

[0062] 204. The MAC entity determines a user equipment that needs to be scheduled.

[0063] The determining, by the MAC entity, a user equipment that needs to be scheduled may be specifically: collecting, by the MAC entity, an ACK or NACK message fed back from the user equipment and when an ACK is received, it considers that the user equipment needs to be scheduled.

[0064] In this embodiment, the MAC entity may schedule multiple user equipments simultaneously. In this embodiment, only one user equipment is used as an example, but is not intended to limit the present invention.

[0065] 205. The MAC entity acquires the service data and the control information from the data buffer of the RLC agent.

[0066] In this embodiment, the RLC agent may buffer service data and control information for multiple user equipments. In this embodiment, only one user equipment is used as an example, but is not intended to limit the present invention.

[0067] 206. The MAC entity sends the service data to the user equipment.

[0068] The steps 205-206 may be specifically:

the MAC entity sends a service data allocation request to the RLC agent, and the RLC agent performs RLC packet assembly on the service data and sends it to the MAC entity; and the MAC entity performs MAC packet assembly on the service data experiencing the RLC packet assembly and sends it to the user equipment;

or,

the MAC entity sends a service data allocation request to the RLC agent and receives the service data of the user equipment from the RLC agent; and the MAC entity performs RLC packet assembly and

MAC packet assembly on the service data of the user equipment and sends the service data experiencing the MAC packet assembly to the user equipment.

[0069] In this embodiment, the performing RLC packet assembly on the service data of the user equipment may be specifically classified into the following several situations:

(1) if RLC PDU segment packet assembly is performed during a previous transmission time interval (Transmission Time Interval, TTI), performing RLC PDU Segment packet assembly;
(2) if only one sequence number (Sequence Number, SN) is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
(3) in a situation rather than the preceding two situations, performing RLC PDU packet assembly.

[0070] In this embodiment, an RLC entity allocates service data in advance for a carrier according to information, such as bearer information, reported by an MAC entity, and sends the service data to an RLC agent for buffering. When the MAC entity needs to schedule a user equipment, it directly reads the service data from the data buffer. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

[0071] The method provided by the embodiment of the present invention may be applied between different boards inside a baseband unit BBU of a base station, and may also be applied between two or more baseband processing unit BBUs.

[0072] Embodiments of the present invention further provide an apparatus embodiment that implements the methods or steps of the foregoing method embodiments. Details of a part of the steps are not described in detail in the apparatus embodiment. Reference may be made to the foregoing method embodiments.

[0073] FIG. 3 is a schematic structural diagram of a base station according to an embodiment of the present invention. As shown in FIG. 3, the base station includes:

a carrier CC301 and an RLC entity 302, where the carrier CC301 includes an MAC entity 3011 and a data buffer 3012.

[0074] The MAC entity 3011 is configured to report bearer information of the carrier CC301 to the RLC entity 302;
the RLC entity 302 is configured to allocate service data and control information to the carrier and send the service data and the control information to the data buffer 3012; and
the MAC entity 3011 is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the data buffer 3012, perform RLC packet assembly and MAC packet assembly on the service data, and send the service data experiencing the packet assembly to the user equipment.

[0075] In this embodiment, the bearer information of the carrier includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, a rate that the carrier can provide for a user equipment, and the like.

[0076] The RLC entity may also be another service entity having a service scheduling function.

[0077] The control information mainly refers to header information, such as a number of a logical channel, a sequence number, or a data length of the service data, required for performing the RLC packet assembly on the service data.

[0078] The allocating, by the RLC entity 302, service data and control information to the carrier may be specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

[0079] The performing, by the MAC entity 3011, RLC packet assembly on the service data may be specifically classified into the following several situations:

(1) if RLC PDU segment packet assembly is performed during a previous transmission time interval (Transmission Time Interval, TTI), performing RLC PDU Segment packet assembly;
(2) if only one sequence number (Sequence Number, SN) is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
(3) in a situation rather than the preceding two situations, performing RLC PDU packet assembly.

[0080] In the base station according to this embodiment, an RLC entity allocates service data in advance for a carrier according to information, such as bearer information, reported by an MAC entity, and sends the service data to a data buffer of the carrier. When the MAC entity needs to schedule a user equipment, it directly reads the service data from the data buffer. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

[0081] FIG. 4 is a schematic structural diagram of another base station according to an embodiment of the present invention. As shown in FIG. 4, the base station includes:

a carrier CC401, an RLC entity 402, and an RLC

agent 403, where the CC401 includes an MAC entity 4011.

[0082] The MAC entity 4011 is configured to report bearer information of the carrier CC401 to the RLC entity 402;
the RLC entity 402 is configured to allocate service data and control information to the carrier and further configured to send the service data and the control information to the RLC agent 403 for buffering;
the RLC agent 403 is configured to buffer the service data and the control information; and
the MAC entity 4011 is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the RLC agent 403, and send the service data to the user equipment.

[0083] In this embodiment, the bearer information of the carrier includes at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, a rate that the carrier can provide for a user equipment, and the like.

[0084] The RLC entity may also be another service entity having a service scheduling function.

[0085] The control information mainly refers to header information, such as a number of a logical channel, a sequence number, or a data length of the service data, required for performing RLC packet assembly on the service data.

[0086] The allocating, by the RLC entity, service data and control information to the carrier may be specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

[0087] The determining, by the MAC entity, a user equipment that needs to be scheduled may be specifically: collecting, by the MAC entity, an ACK or NACK message fed back from the user equipment and when an ACK is received, it considers that the user equipment needs to be scheduled.

[0088] The acquiring, by the MAC entity 4011, the service data and the control information from the RLC agent 403 and sending the service data to the user equipment may be specifically:

sending, by the MAC entity, a service data allocation request to the RLC agent, and performing, by the RLC agent, RLC packet assembly on the service data and sending it to the MAC entity; and performing, by the MAC entity, MAC packet assembly on the service data experiencing the RLC packet assembly and sending it to the user equipment;
or,
sending, by the MAC entity, a service data allocation request to the RLC agent and receiving the service data of the user equipment from the RLC agent; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data of the user equipment and sending the service data experiencing the MAC packet assembly to the user equipment.

[0089] In this embodiment, the performing, by the RLC agent or the MAC entity, RLC packet assembly on the service data of the user equipment may be specifically classified into the following several situations:

(1) if RLC PDU segment packet assembly is performed during a previous transmission time interval (Transmission Time Interval, TTI), performing RLC PDU Segment packet assembly;
(2) if only one sequence number (Sequence Number, SN) is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
(3) in a situation rather than the preceding two situations, performing RLC PDU packet assembly.

[0090] In this apparatus embodiment, an RLC entity allocates service data in advance for a carrier according to information, such as bearer information, reported by an MAC entity, and sends the service data to an RLC agent for buffering. When the MAC entity needs to schedule a user equipment, it directly reads the service data from the data buffer. This implements decoupling between service data transmission from the RLC entity to the MAC entity and service scheduling by the MAC entity and prevents that a rather high bandwidth is required between boards.

[0091] It should be noted that the MAC entity, RLC entity, RLC agent and the like in the embodiments of the present invention may also be called a unit, a module or the like, and is classified merely by functions or in logic. They may be specifically in a form of software, using a processor to execute program code to implement their functions; and may also be in a form of hardware, or in another form of a combination of software and hardware, which is not limited in the present invention. For example, in the apparatus embodiments corresponding to FIG. 3 and FIG. 4, the MAC entity 3011 and the RLC entity 302 may be separately implemented by using a processor to invoke a corresponding program or pure hardware, and the MAC entity 4011, the RLC entity 402, and the RLC agent 403 may be separately implemented by using a processor to invoke a corresponding program or pure hardware.

[0092] Based on the description in the foregoing embodiments, a person skilled in the art may be clearly aware that the present invention may be implemented through hardware, or firmware, or a combination thereof. When the present invention is implemented through software, the foregoing functions may be stored in a computer readable medium, or transmitted as one or more commands or code on the computer readable medium. The

computer readable medium includes a computer storage medium and a communications medium. The communications medium includes any medium that facilitates transmission of a computer program from one place to another place. The storage medium may be any available medium accessible to a computer. The following is taken as an example but is not limited: The computer readable medium may include an RAM, an ROM, an EEPROM, a CD-ROM or other optical disc storage, a disk storage medium or other disk storage, or any other medium that can be used to carry or store an expected program code in a command or data structure form and can be accessed by a computer. In addition, any connection may appropriately become a computer readable medium. For example, if the software implements the transmission from a website, a server, or other remote sources by using a coaxial cable, an optical cable, a twisted pair, a digital subscriber line (DSL), or a wireless technology such as infrared, radio, or microwave, the coaxial cable, the optical cable, the twisted pair, the DSL, or the wireless technology such as infrared, radio, or microwave is included in fixation of a home medium. For example, a disk (Disk) and a disc (disc) used in the present invention include a compact disc (CD), a laser disc, an optical disc, a digital versatile disc (DVD), a floppy disk, and a blue-ray disc. Usually a disk magnetically duplicates data, while a disc optically duplicates data by using laser. A combination of the foregoing should also be covered in the protection scope of a computer readable medium.

[0093] In summary, the foregoing describes only exemplary embodiments of the technical solutions of the present invention and is not intended to limit the protection scope of the present invention. Any modification, equivalent replacement, or improvement made within the spirit and principle of the present invention shall fall within the protection scope of the present invention.

Claims

1. A service scheduling method, comprising:

reporting, by a Medium Access Control MAC entity of a carrier, bearer information of the carrier to a Radio Link Control RLC entity;
allocating, by the Radio Link Control RLC entity, service data and control information to the carrier, and sending the service data and the control information to a data buffer of the carrier;
determining, by the MAC entity, a user equipment that needs to be scheduled, and acquiring the service data and the control information from the data buffer; and
performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data and sending the service data experiencing the packet assembly to the user equipment.

2. The method according to claim 1, wherein the bearer information comprises at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

3. The method according to claim 1, wherein the control information is a number of a logical channel, a sequence number, or a data length of the service data.

4. The method according to any one of claims 1 to 3, wherein the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

5. The method according to claim 1, wherein the performing, by the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;
if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

6. A service scheduling method, comprising:

reporting, by a Medium Access Control MAC entity of a carrier, bearer information of the carrier to a Radio Link Control RLC entity;
allocating, by the RLC entity, service data and control information to the carrier, and sending the service data and the control information to a data buffer of an RLC agent;
determining, by the MAC entity, a user equipment that needs to be scheduled; and
acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment.

7. The method according to claim 6, wherein the bearer information comprises at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

8. The method according to claim 6, wherein the control

information is a number of a logical channel, a sequence number, or a data length of the service data.

9. The method according to any one of claims 6 to 8, wherein the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the RLC agent, and a buffer status of the RLC entity.

10. The method according to claim 6, wherein the acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment is specifically:

sending, by the MAC entity, a service data allocation request to the RLC agent, and performing, by the RLC agent, RLC packet assembly on the service data and sending the service data experiencing the RLC packet assembly to the MAC entity; and performing, by the MAC entity, MAC packet assembly on the service data experiencing the RLC packet assembly and sending the service data experiencing the MAC packet assembly to the user equipment;
or,
sending, by the MAC entity, a service data allocation request to the RLC agent and receiving the service data of the user equipment from the RLC agent; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data of the user equipment and sending the service data experiencing the MAC packet assembly to the user equipment.

11. The method according to claim 10, wherein the performing, by the RLC agent or the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;
if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

12. Abase station, comprising:

a carrier and a Radio Link Control RLC entity, wherein the carrier comprises a Medium Access Control MAC entity and a data buffer;
the MAC entity is configured to report bearer information of the carrier to the RLC entity;
the RLC entity is configured to allocate service data and control information to the carrier and send the service data and the control information to the data buffer; and
the MAC entity is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the data buffer, perform RLC packet assembly and MAC packet assembly on the service data, and send the service data experiencing the packet assembly to the user equipment.

13. The base station according to claim 12, wherein the bearer information of the carrier comprises at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

14. The base station according to claim 12, wherein the control information is a number of a logical channel, a sequence number, or a data length of the service data.

15. The base station according to any one of claims 12 to 14, wherein the allocating, by the RLC entity, service data and control information to the carrier is specifically: allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a data buffer status of the carrier, and a buffer status of the RLC entity.

16. The base station according to claim 12, wherein the performing, by the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;
if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

17. Abase station, comprising:

a carrier, a Radio Link Control RLC entity, and an RLC agent, wherein the carrier comprises a Medium Access Control MAC entity;
the MAC entity is configured to report bearer in-

formation of the carrier to the RLC entity;
the RLC entity is configured to allocate service data and control information to the carrier and send the service data and the control information to the RLC agent for buffering;
the RLC agent is configured to buffer the service data and the control information; and
the MAC entity is further configured to determine a user equipment that needs to be scheduled, acquire the service data and the control information from the RLC agent, and send the service data to the user equipment.

18. The base station according to claim 17, wherein the bearer information comprises at least one of the following: quality of a channel corresponding to the carrier, a load of the carrier, and a rate that the carrier can provide for all user equipments.

19. The base station according to claim 17, wherein the control information is a number of a logical channel, a sequence number, or a data length of the service data.

20. The base station according to any one of claims 17 to 19, wherein the allocating, by the RLC entity, service data and control information to the carrier is specifically:

allocating, by the RLC entity, the service data and the control information to the carrier according to the bearer information, a buffer status of the RLC agent, and a buffer status of the RLC entity.

21. The base station according to claim 17, wherein the acquiring, by the MAC entity, the service data and the control information from the data buffer of the RLC agent and sending the service data to the user equipment is specifically:

sending, by the MAC entity, a service data allocation request to the RLC agent, and performing, by the RLC agent, RLC packet assembly on the service data and sending the service data experiencing the RLC packet assembly to the MAC entity; and performing, by the MAC entity, MAC packet assembly on the service data experiencing the RLC packet assembly and sending the service data experiencing the MAC packet assembly to the user equipment;
or,
sending, by the MAC entity, a service data allocation request to the RLC agent and receiving the service data of the user equipment from the RLC agent; and performing, by the MAC entity, RLC packet assembly and MAC packet assembly on the service data of the user equipment and sending the service data experiencing the MAC packet assembly to the user equipment.

22. The base station according to claim 21, wherein the performing, by the RLC agent or the MAC entity, RLC packet assembly on the service data is specifically:

if radio link control packet data unit segment RLC PDU segment packet assembly is performed during a previous transmission time interval TTI, performing RLC PDU Segment packet assembly;
if only one sequence number SN is left currently and the service data cannot all be allocated in a current TTI at a time, performing RLC PDU segment packet assembly; and
in a situation rather than the preceding two situations, performing radio link control packet data unit RLC PDU packet assembly.

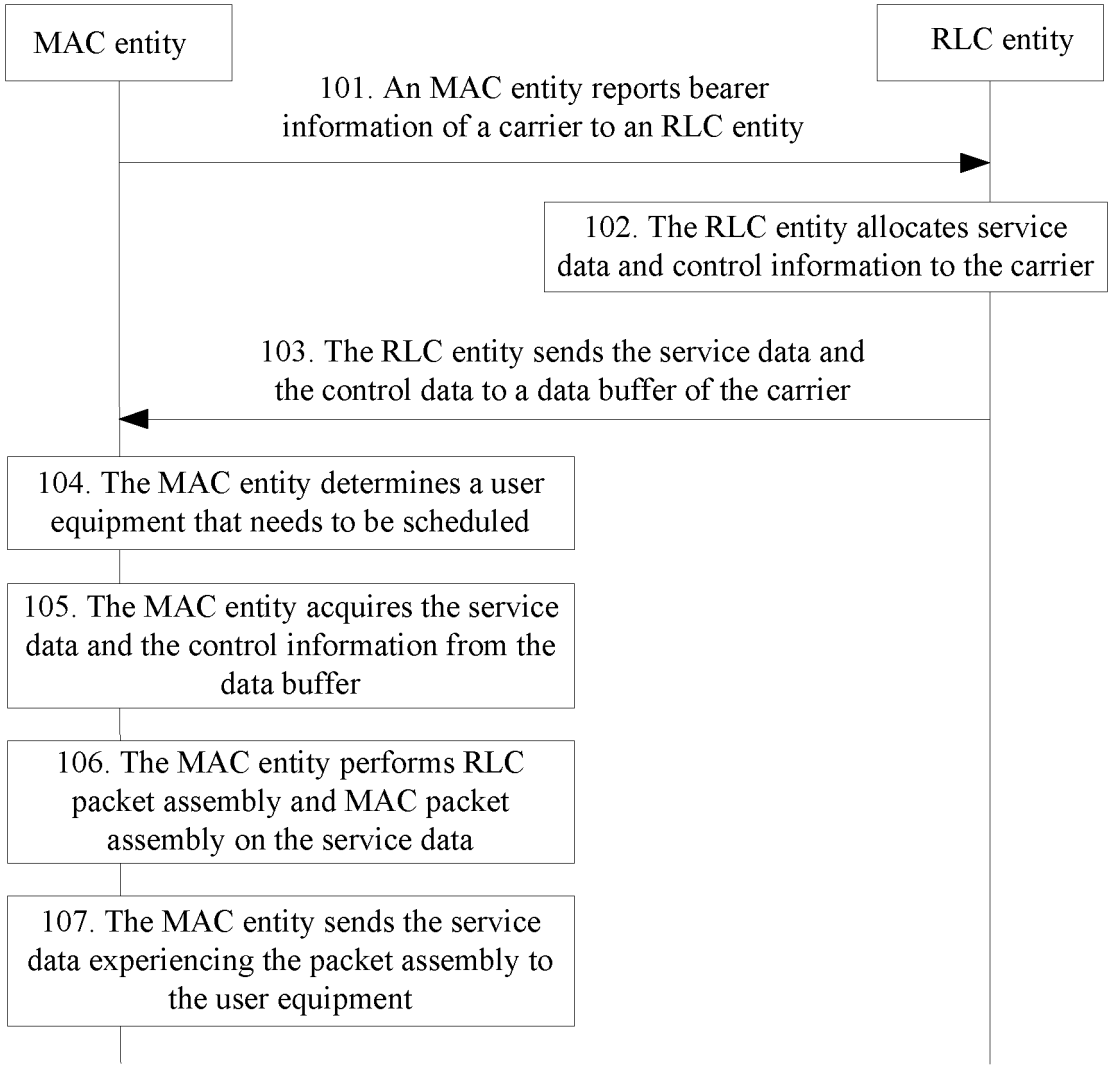
MAC entity
RLC entity
101. An MAC entity reports bearer information of a carrier to an RLC entity
102. The RLC entity allocates service data and control information to the carrier
103. The RLC entity sends the service data and the control data to a data buffer of the carrier
104. The MAC entity determines a user equipment that needs to be scheduled
105. The MAC entity acquires the service data and the control information from the data buffer
106. The MAC entity performs RLC packet assembly and MAC packet assembly on the service data
107. The MAC entity sends the service data experiencing the packet assembly to the user equipment

FIG. 1

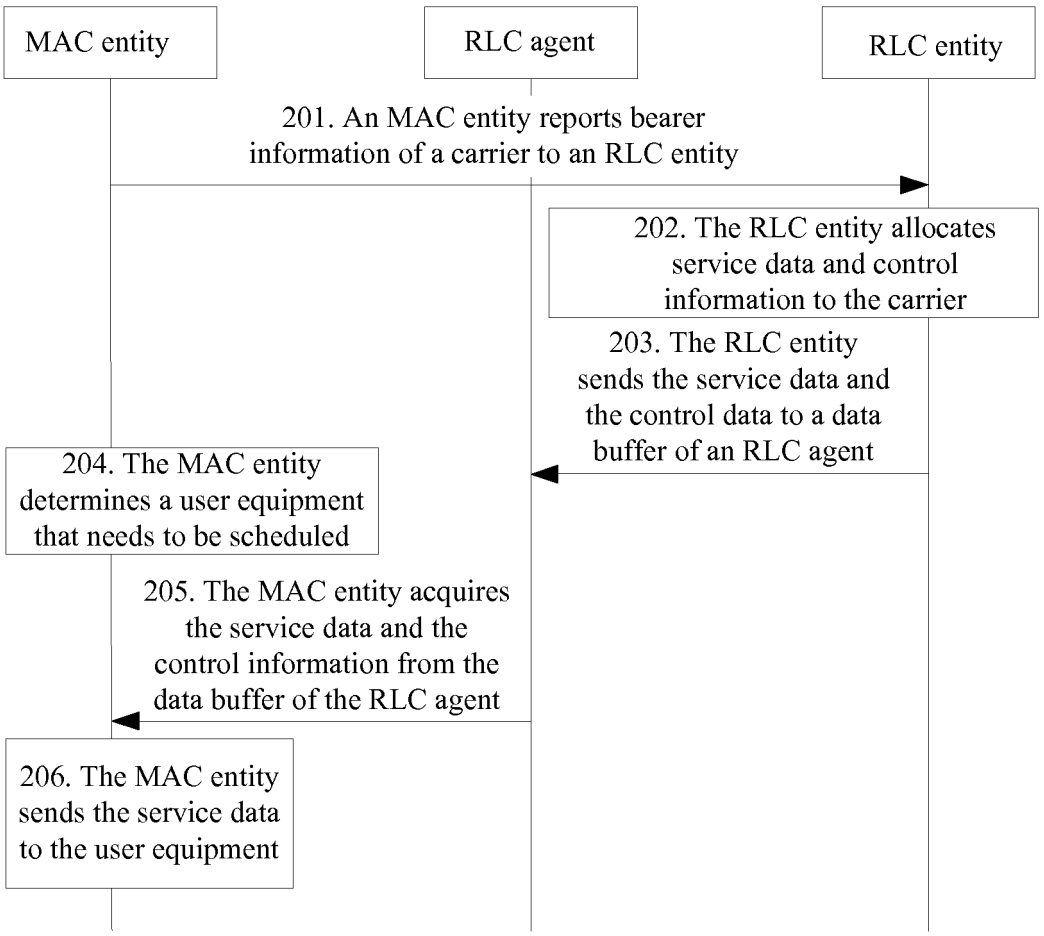
MAC entity
RLC agent
RLC entity
201. An MAC entity reports bearer information of a carrier to an RLC entity
202. The RLC entity allocates service data and control information to the carrier
203. The RLC entity sends the service data and the control data to a data buffer of an RLC agent
204. The MAC entity determines a user equipment that needs to be scheduled
205. The MAC entity acquires the service data and the control information from the data buffer of the RLC agent
206. The MAC entity sends the service data to the user equipment

FIG. 2

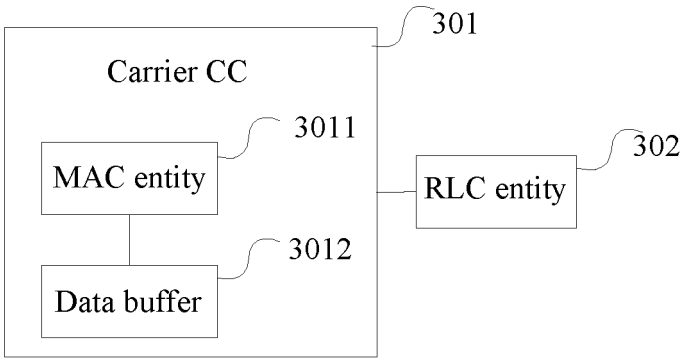
301
Carrier CC
3011
MAC entity
302
RLC entity
3012
Data buffer

FIG. 3

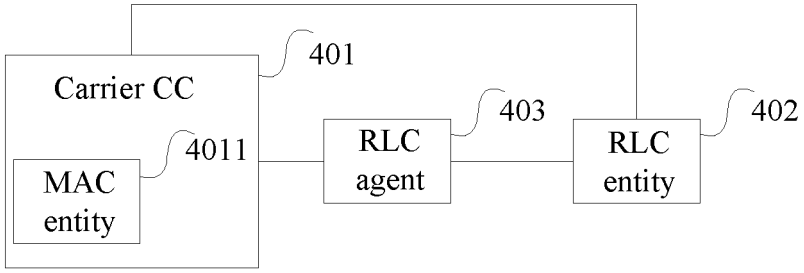

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/081966

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/00 (2009.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W; H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, GOOGLE, CNKI: service, scheduling, media w access w control w unit, radio w link w control, bearer w information (in Chinese), MAC, RLC, traffic w scheduling, multi w carrier, component carrier, buffer, allocate+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010215006 A1 (QUALCOMM INCORPORATED) 26 August 2010 (26.08.2010) the abstract, and claims 1-22	1-22
A	CN 101296027 A (DATANG MOBILE COMMUNICATIONS EQUIPMENT CO., LTD et al.) 29 October 2008 (29.10.2008) the whole document	1-22
A	CN 1972462 A (DATANG MOBILE COMMUNICATIONS EQUIPMENT CO., LTD et al.) 30 May 2007 (30.05.2007) the whole document	1-22

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 April 2014	16 May 2014

Name and mailing address of the ISA	Authorized officer
State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	WU, Xinghua Telephone No. (86-10) 62089556

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/081966

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US 2010215006 A1	26 August 2010	CN 102301632 A	28 December 2011
		WO 2010088538 A8	17 March 2011
		US 8638773 B2	28 January 2014
		JP 2012516663 A	19 July 2012
		EP 2392180 A2	07 December 2011
		TW 201116134 A	01 May 2011
		WO 2010088538 A3	16 September 2010
		KR 20110118699 A	31 October 2011
		WO 2010088538 A2	05 August 2010
CN 101296027 A	29 October 2008	CN 101296027 B	10 October 2012
CN 1972462 A	30 May 2007	CN 100431362 C	05 November 2008

Form PCT/ISA /210 (patent family annex) (July 2009)